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AIR DISPERSION MODELING GUIDANCE DOCUMENT

AIR QUALITY DIVISION

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY

2008

Air Quality Dispersion Modeling

PAGE

Introduction to Modeling

Dispersion modeling is a tool for predicting source ambient impacts through computer simulations. Use of air dispersion modeling is often required to demonstrate compliance with various state and federal ambient air quality standards. The primary federal Environmental Protection Agency's (EPA's) modeling guidance document is the "Guideline on Air Quality Models," 40 CFR Part 51, Appendix W, which may be found at EPA's Support Center for Regulatory Atmospheric Modeling (SCRAM) website at the following web address (http://www.epa.gov/scram001/). This guidance should be applied to air use permit new source review and prevention of significant deterioration (PSD) modeling to ensure consistency and EPA acceptability in the air quality analysis. The information below reiterates much of the information found in Appendix W and also provides more detailed and specific recommendations applicable to Michigan.

1.0 Prevention of Significant Deterioration (PSD) Dispersion Modeling

All air use permit applications for major sources or major modifications of criteria pollutants in an attainment or unclassified area must submit PSD increment modeling for PM10/PM2.5, SO_2 and NO_2 along with National Ambient Air Quality Standard (NAAQS) modeling for PM10, SO_2, NO_2, CO and lead. The modeling analysis usually involves two distinct phases: 1) a **preliminary analysis,** and 2) a **full impact analysis.** The preliminary analysis models only the significant increase in potential emissions from a proposed new source or the significant "net" increase from a proposed modification. Significant emission increases are those at or above the tons per year values listed in **Table 1**. If it can be demonstrated that these emissions would not increase ambient concentrations by more than the prescribed significant impact levels listed in Table 1 (based on first high impacts), no further modeling would be required. If, however, the impact is significant, applicants are required to conduct a full impact analysis, which, in Michigan, consists of the following three modeling demonstrations:

1. The applicant does not consume more than 80% of the PSD Class II increment.
2. The applicant plus other increment consuming facilities nearby do not consume more than 100% of increment.
3. All emissions in the area meet the NAAQS.

For both the preliminary and full impact analysis, the PSD modeling is required to use five years of the most recent and representative meteorological data. However, if at least a year of quality assured site specific data is available this data would be preferred for use in the analysis.

No significant ambient concentration for ozone has been established. Instead, any net emission increase of 100 tons or more per year of volatile organic compounds (VOCs) would need to address the impact of these emissions. Since ozone modeling can be complex and resource intensive, other indirect and qualitative approaches can be used, which are discussed further in Section 3.4.

In Michigan, increment consumption is considered to occur as a result of emissions from minor sources, as well as major sources or major modifications. Thus, PSD increment and NAAQS modeling are generally also required from any new or modified **minor source** if the proposed emission increase is above the significant emission amounts shown in Table 1. For minor

TABLE 1 – GENERAL POLLUTANT INFORMATION

Pollutants	Term	NAAQS		Episode Levels			PSD Permitted Increments			Signif. Emissions Increase	Monitoring Exemption Levels		Signif. Impact Levels
		Primary ($\mu g/m^3$)	Secondary ($\mu g/m^3$)	Alert ($\mu g/m^3$)	Warn ($\mu g/m^3$)	Emergency ($\mu g/m^3$)	1 ($\mu g/m^3$)	2 ($\mu g/m^3$)	3 ($\mu g/m^3$)	(ton/yr)	($\mu g/m^3$)	Term	($\mu g/m^3$)
TSP	Ann	75	60				5	19	37	25			1
	24-hr.	260	150	375	625	875	10	37	75		10.0	24-hr.	5
PM10 **	Ann	50	50				4	17	34	15			1
	24-hr.	150	150				8	30	60		10.0	24-hr.	5
PM2.5	Ann	15	15										
	24-hr.	35	35										
SO_2	Ann	80					2	20	40	40			1
	24-hr.	365		800	1,600	2,100	5	91	182		13.0	24-hr.	5
	3-hr.		1300				25	512	700				25
CO	8-hr.	10,000	10,000	17,000	34,000	46,000				100	575.0	8-hr.	500
	1-hr.	40,000	40,000										2,000
NO_2	Ann	100	100				2.5	25	50	40	14.0	Ann	1
	8-hr.			282	565	750							
	1-hr.			130	2,260	3,000							
Ozone	1-hr.	235	235							40 voc	100.0	Ton/yr	
Lead	3 mth	1.5	1.5							0.6	0.1	3- mth	

** Note**:** Due to a lack of evidence linking health problems to long-term exposure to coarse particle pollution, the EPA revoked the annual PM_{10} standard in 2006 (effective December 17, 2006).

source modeling, however, the applicant can either perform their own modeling or elect to have the Air Quality Division (AQD) conduct the modeling. In either case, all the necessary information listed in Appendix A should be included with the permit application. Criteria pollutant modeling for sources not subject to PSD have the option of either using one year of the most recent and representative meteorological data or five years of meteorological data; however, if only one year of off-site data is used, the design values must be based on the first high impacts.

2.0 PSD and NAAQS Emission Inventories

NAAQS are maximum concentration "ceilings," which are the sums of ambient impacts from existing sources of air pollution, background, and the applicant's proposed emissions. The emission rates used in a NAAQS analysis should be based on the "allowable" emission rates because the applicant must demonstrate that the NAAQS would be met and maintained into the future should sources emit up to their allowed levels.

PSD increments, on the other hand, are the maximum allowable increases in ambient concentrations that are allowed to occur above the baseline concentration in an area from emission increases that have occurred since the applicable baseline date. Applicable baseline dates are posted in the "Modeling and Meteorology" section of AQD's website. The PSD increment can also be expanded from emission decreases or source shutdowns which may be represented in the modeling by negative emission rates. Increment can also be expanded or consumed by a **creditable** change in stack height to the extent the change affects ambient concentrations in the same manner as an emission decrease or increase.

PSD emission rates used in the increment demonstration may be based on actual representative emissions; however, in the case of sources with little or no operating data at the time of the increment analysis, the potential to emit must be used. To request pollutant emission rates and stack parameters for facilities located near a source seeking a permit which needs to conduct a complete PSD and NAAQS dispersion modeling analysis contact Jim Haywood of the AQD at 517-241-7478 (haywoodj@michigan.gov). More information can be found in the EPA document titled "New Source Review Workshop Manual (Oct 1990)," available from our website.

3.0 PSD & NAAQS Pollutant Specific Design Values

3.1 Carbon Monoxide (CO), Sulfur Monoxide (SO2), Nitrogen Dioxide (NO2)

The PSD and NAAQS standards for the criteria pollutants with 1-hr, 3-hr, 8-hr, and 24-hr averaging times are deterministic standards. In other words, they cannot be exceeded more than once per calendar year. When conducting a PSD and NAAQS analysis for short-term periods (non-annual) using five years of meteorological data or one or more years of site specific data, the highest of the second highest concentrations predicted from any of the years should be used as the estimate. The annual average design value should be based on the highest annual impact from any of the years used. Annual NOx estimates may be adjusted by multiplying the design value by an empirically derived national default NO_2/NOx equilibrium value of 0.75 before comparison to the NO_2 PSD increment and NAAQS.

3.2 Particulate Matter PSD and NAAQS Analysis

The EPA guidance for modeling PM2.5 is not finalized at this time and until then PM10 modeling should be used as the surrogate when conducting a full impact analysis for Particulate. When conducting a 24-hr average PM10 PSD analysis utilizing five years of meteorological data, the highest second high impact from any of the five years should be used similar to SO_2. For the 24-hr PM10 NAAQS analysis, however (which is a probabilistic standard), the highest sixth highest concentration for the whole period becomes the design value. Another way of stating this is that the PM10 24-hour NAAQS is met when the expected number of exceedances is less than or equal to one. The design value for the annual PM10 PSD and NAAQS analysis should be based on the highest annual impact from any of the 5 years used.

NOTE: While the U.S. Environmental Protection Agency's (EPA's) July 18, 1997 rulemaking (62 FR 38652) modified the PM10 NAAQS, the US Court of Appeals vacated the modification on May 14, 1999. Until EPA provides further guidance regarding modeling PM2.5 impacts, the modeling procedure for particulate will rely on the EPA's pre-1997 PM10 guidance (as described above).

The PM2.5 24-hour standard is violated if the 98th percentile monitored concentration, averaged over a three-year period, is greater than 35 µg/m^3. The PM2.5 average annual arithmetic mean, over a three-year period, must not exceed 15 µg/m^3.

3.3 Lead (Pb)

Lead has a NAAQS value of 1.5 µg/m^3 on an individual calendar quarterly (3-month) average basis. Since the preferred refined models are able to report maximum monthly average concentrations directly, evaluations are typically made using this conservative maximum monthly average concentration or maximum 24-hr average concentration estimate in lieu of determining the maximum calendar quarterly average concentration for ease of computation.

3.4 Ozone

No significant ambient impact concentration has been established for ozone. Instead, any net emissions increase of 100 tons per year of VOCs subject to PSD would be required to address the impact of the emissions. Options include the Reactive Plume Model (RPM) however, for most sources the AQD conducts a city by city emission comparison to satisfy the NSR obligations. As an example of the comparison, proposed VOC emissions from a facility locating in Marquette would be added to the other VOC emissions in the area and compared to another city with larger total VOCs emission that is in attainment with the ozone standard. By comparison therefore, the proposed source should not cause any ozone NAAQS exceedance problems. Before employing any of these techniques, the applicant should contact the AQD modeling staff. In some cases, post construction monitoring may be used in lieu of ozone modeling.

For nonattainment areas, modeling is not required. The AQD's Part 2 offset rules require that all proposed major offset sources or major offset modifications offset any new VOC emissions by obtaining emissions reductions in amounts greater than the new emissions by a specified percentage such that the area would experience a net overall decrease in VOC emissions.

4.0 PSD Additional Impact Analysis

All PSD permit applicants must prepare an additional impact analysis for each pollutant subject to PSD (i.e., emitted at greater than their significant emissions threshold). This analysis assesses the impacts on soils, vegetation, and visibility caused by any increase in emissions of a regulated NSR pollutant from the source or modification under review. In most cases, emissions increases will not have adverse impacts on soils, vegetation, or visibility. Regardless, the additional impacts analysis must be performed. Although each applicant for a PSD permit must perform an additional impacts analysis, the depth of the analysis generally will depend on existing air quality, the quantity of emissions, and the sensitivity of local soils, vegetation, and visibility in the source's impact area. It is important that the analysis fully document all sources of information, underlying assumptions, and any agreements made as a part of the analysis. The additional impact analysis generally has three parts: 1) growth, 2) soils and vegetation, and 3) visibility, which are discussed in more detail below.

4.1 Growth Analysis

The elements of a growth analysis include a projection of the associated industrial, commercial, and residential growth that will occur in the area due to the proposed project; and an analysis of the emissions generated by the growth as well as from any construction-related activities.

4.2 Soils and Vegetation

The analysis of impacts on soils and vegetation should be based on an inventory of the soil and vegetation types found in the impact area. This inventory should include all vegetation with any commercial or recreational value and may be available from several sources (i.e., conservation groups and/or universities). For most types of soil and vegetation, ambient concentrations of criteria pollutants below the NAAQS will not result in harmful effects. However, there are sensitive vegetation species that may be harmed by long-term exposure to low concentrations of pollutants. Good references include:

- “New Source Review Workshop Manual” (EPA);
- “Air Quality Criteria Documents” (EPA);
- “Impacts of Coal-Fired Plants on Fish, Wildlife, and Their Habitats” (U.S. Department of the Interior);
- “A Screening Procedure to Evaluate Air Pollution Effects on Class I Wilderness Areas” (U.S. Forest Service); and
- “Air Quality in the National Parks” (National Park Service).

4.3 Local Visibility

In the visibility impairment analysis, the applicant is especially concerned with impacts that occur within the area affected by applicable emissions. Note that the visibility analysis required here is distinct from the Class I area visibility analysis requirement. The suggested components of a good visibility impairment analysis are:

- A determination of the visual quality of the area;
- An initial screening of emission sources to assess the possibility of visibility impairment; and
- If warranted, a more in-depth analysis involving computer models.

To successfully complete a visibility impairments analysis, the applicant is referred to an EPA document titled “Workbook for Plume Visual Impact Screening and Analysis,” available from National Technical Information Service, 1988. The workbook outlines a screening procedure designed to expedite the analysis of emissions impacts on the visual quality of an area. The workbook was designed for Class I area impacts, but the outlined procedures are generally applicable to other areas. The VISCREEN model available from the EPA’s SCRAM website is often used for these demonstrations.

4.4 Icing and Fogging

The potential for adverse effects from icing and fogging of nearby roads from mechanical draft cooling towers should be evaluated as part of a PSD additional impact analysis. Fogging is assumed to occur when the visible plume strikes the ground. Icing occurs when the visible plume strikes the ground under freezing conditions. This may be accomplished by utilizing the Seasonal/Annual Cooling Tower Model. The meteorological data used with this model is in a different file format compared to other modeling programs. Contact Jim Haywood at 517-241-7478 (haywoodj@michigan.gov) for more information on this model and/or for meteorological data.

4.5 Class I Area Impacts (PSD, Visibility, Air Quality Related Values)

Class I areas are areas of special national or regional natural, scenic, recreational, or historic value for which the PSD regulations provide special protection. Michigan contains two Class I areas:

1. Seney National Wildlife Refuge; and
2. Isle Royale National Park

One way in which air quality degradation is limited in all Class I areas is by more stringent limits defined by the **PSD Class I increment thresholds** shown in Table 1. The increments are the maximum increases in ambient pollutant concentrations allowed over baseline concentrations. The Class I increments more stringently limit increases in ambient pollutant concentrations caused by new major sources or major modifications than do the Class II increments. PSD regulations require a PSD increment and NAAQS analysis of any PSD source when the emissions increase pollutant concentrations by 1 $\mu g/m^3$ or more (24-hr avg) in a class I area. If a Class I area increment and NAAQS analysis is required, modeling for Class I areas should include not only emissions from the proposed source, but also other sources that may consume increment in the Class I area similar to PSD increment analyses elsewhere in the state.

Also applicable to Class I areas are Air Quality Related Values (AQRV's) which are features or properties of the Class I area that could be adversely affected by air pollution even if the pollutant concentrations do not exceed the Class I increments. The Clean Air Act (CAA) gave the Federal land managers (FLMs) an affirmative responsibility to protect AQRVs and they are responsible for evaluating a source's projected impact on a Class I area's AQRV's. These AQRV's include visibility, vegetation, lakes and streams, soils, fish, animals, and monuments. The appropriate Federal Land Manager can discuss specific AQRVs for a particular Class I area and advise the applicant of the level of analyses needed to assess potential impacts on these resources and the appropriate methods that should be employed. AQRV information for Michigan's Class I area's can be obtained from the following National Park Service web site at http://www.nature.nps.gov/air/Permits/Aris/index.cfm

FEDERAL LAND MANAGERS (FLM's) NOTIFICATION

Section 165 of the Clean Air Act (CAA) requires the Environmental Protection Agency or the state permitting authority to provide written notification to the Federal Land Manager (FLM) if a proposed major or major modification **"*may affect*"** a Class I area. Generally, the permitting authority should notify the FLM of all new or modified major facilities proposing to locate within 100 km (62 miles) of a Class I area. Also, as mentioned in an EPA memo dated March 19, 1979 to the Regional Administrators (attachment 1) and in the Federal Land Managers' Air Quality Related Values Workgroup (FLAG) Phase I Report available from the web link at http://www.nature.nps.gov/air/permits/flag/flagDoc/flmNew.cfm, the permitting authority should notify the FLM of "very large sources" with the potential to affect Class I areas proposing to locate at distances greater than 100 km. Given the multitude of possible size/distance combinations, the FLMs can not precisely define in advance what constitutes a "very large source" located more than 100 km away that may impact a particular Class I area. Therefore, the FLM and permitting authority will work together to determine which PSD applications the FLM is to be made aware of in excess of 100 km. The FLM and permitting authority will make this determination on a case-by-case basis, considering such factors as magnitude of emissions, current conditions of air sensitive resources in the Class I area, potential for source growth in an area or region, prevailing meteorological conditions, and cumulative effects of multiple sources to air sensitive resources. Figures 1 and 2 below are maps of Michigan Class I areas which depict 100 km and 300 km buffer distance zones.

PSD applications that "may affect" a Class I area should be sent to the FLM for review and analysis as soon as possible after receipt, giving the FLM an opportunity to review the application concurrently with the permitting authority. The FLM's will keep the Park Superintendent and/or the Refuge Manager informed with respect to any significant actions. Additional procedural requirements apply when a proposed source has the potential to impair visibility in a Class I area (40 CFR §52.27(d)(1998)). Specifically, the permitting authority must notify the FLM in writing and include a copy of all information relevant to the permit application, including the proposed source's anticipated impacts on visibility in a Class I area. The permitting authority should notify the FLM within 30 days of receipt and at least 60 days prior to the close of the comment period. If the FLM notifies the permitting authority that the proposed source may adversely impact visibility in a Class I area, then the permitting authority will work with the FLM to address their concerns. The AQD should be informed of any agreements made between the FLM and the applicant regarding any AQRV's that are to be evaluated or methodologies to be used in the evaluation.

ISLE ROYAL NATIONAL PARK CONTACT INFORMATION

FEDERAL LAND MANAGER	PARK SUPERINDENTANT
John Bunyak, Chief, Policy Planning and Permit Review Branch: NPS Air Resources Division, (303) 969-2818; P.O. Box 25287, Denver CO, 80225 john_bunyak@nps.gov	Park Superintendent Phone Number: (906) 482-0986 87 North Ripley Street Houghton, MI 49931 isro_superintendent@nps.gov

SENEY NATIONAL WILDLIFE REFUGE CONTACT INFORMATION

FEDERAL LAND MANAGER	REFUGE MANAGER
Sandra Silva, Chief , FWS Air Quality Branch Air Quality Branch (303) 969-2814; P.O.Box 25287, Denver CO, 80225 sandra_v_silva@nps.gov	Refuge Manager Phone Number: (906) 586-9851 Seney NWR HCR 2, Box 1, Seney, MI 49883 Mike_Tansy@fws.gov

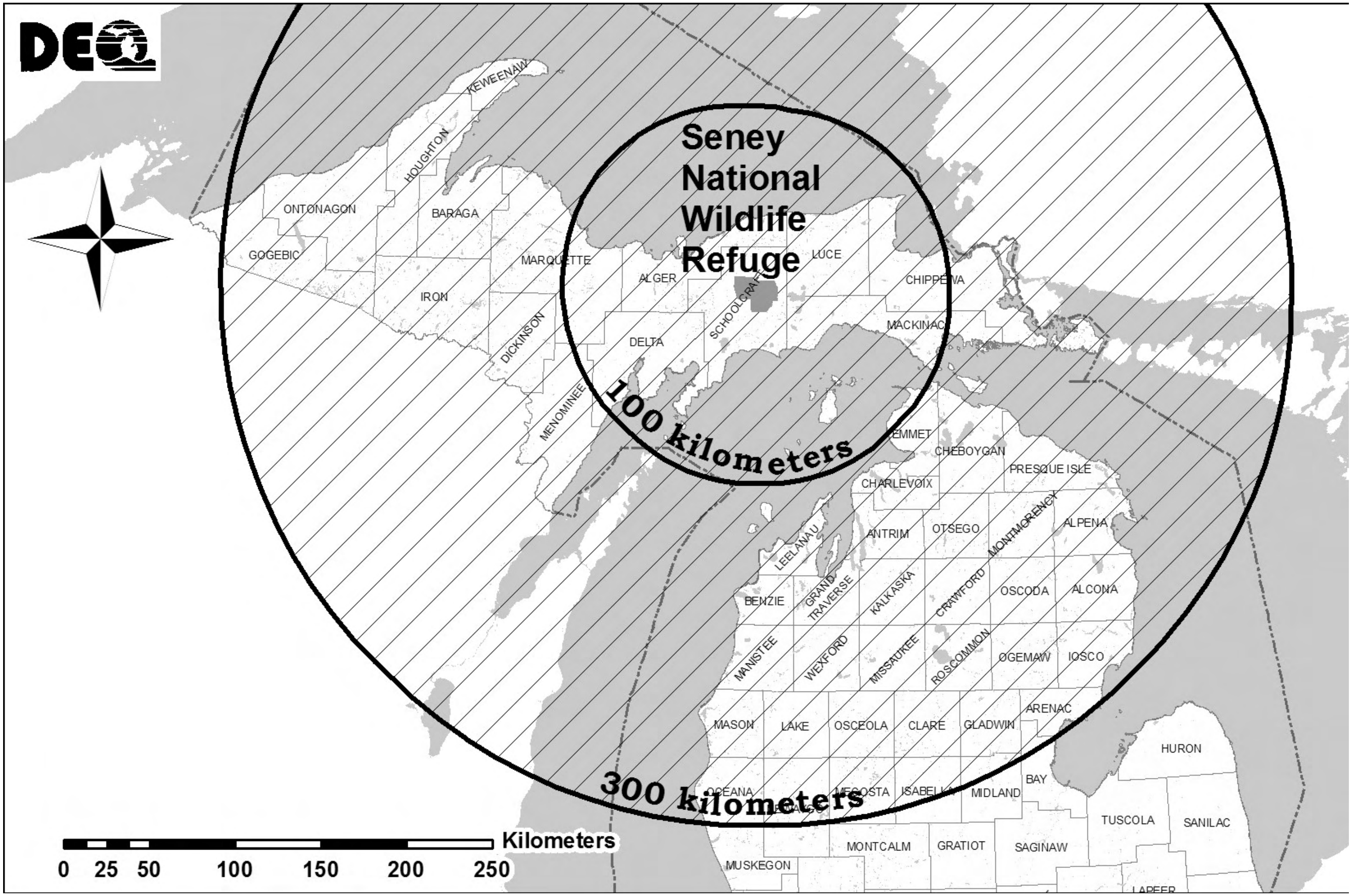
Information on screening models available for visibility analysis can be found in the manual "Workbook for Plume Visual Impact Screening and Analysis," EPA-450/4-88-015 (9/88).
If a more refined modeling assessment is needed, the Calpuff model should be utilized, which has been adopted by the EPA in the "*Guideline on Air Quality Models, Appendix W,*" as the preferred model for assessing long range transport of pollutants and their impacts on Federal Class I areas. Long-range transport is generally considered to apply to distances greater than 50 km from a source. Also, the CALPUFF modeling system is recommended by the Federal Land Managers' Air Quality Related Values Workgroup (FLAG) for assessing the effects of distant and multi-source plumes on visibility and pollutant wet/dry deposition fluxes. The CALPOST processor implements the FLAG recommended algorithms for assessing the change in plume extinction due to a modeled source or group of sources. CALPUFF postprocessors allow the calculation of pollutant deposition fluxes of nitrogen and sulfur as described by the FLAG guidance found in the FLAG Phase I Report (FLAG, 2000). The Interagency Workgroup on Air Quality Modeling (IWAQM) also recommends the use of CALPUFF and the Phase 2 Summary Report (IWAQM, 1998) includes recommendations for conducting refined analyses with CALPUFF of PSD increment consumption, NAAQS impacts and Air Quality Related Value impacts in Class I areas. Links to these documents and the CALPUFF model can be found at EPA's SCRAM web site (http://www.epa.gov/scram001/).

WISCONSIN FOREST COUNTY PATAWATOMI (FCP) CLASS I AREA

On April 29th, 2008 the EPA published in the Federal Register a final rule that became effective on May 29th that redesignated certain portions of the FCP Community Reservation as a non-Federal Class I area under the Clean Air Act program for PSD. This area is located near the state border of Wisconsin and the Upper Peninsula of Mi and may affect Class I modeling requirements for sources located in the western most portion of the Upper Peninsula. The 100 km buffer zone from this area essentially encompasses the Mi counties of Menominee, Dickenson, Iron, and the SE half of Gogebic and is shown as Figure 3 below.

As EPA codified the FCP Community Class I area as part of a Federal Implementation Plan, it is yet unclear as to whether there will be a Federal Land Manager (FLM) or a non-Federal Land Manager (NFLM) for administering Air Quality Related Values (AQRV) and other reviews. Thus, applicants are advised to check with the AQD for any updated information regarding FLM or NFLM notification requirements.

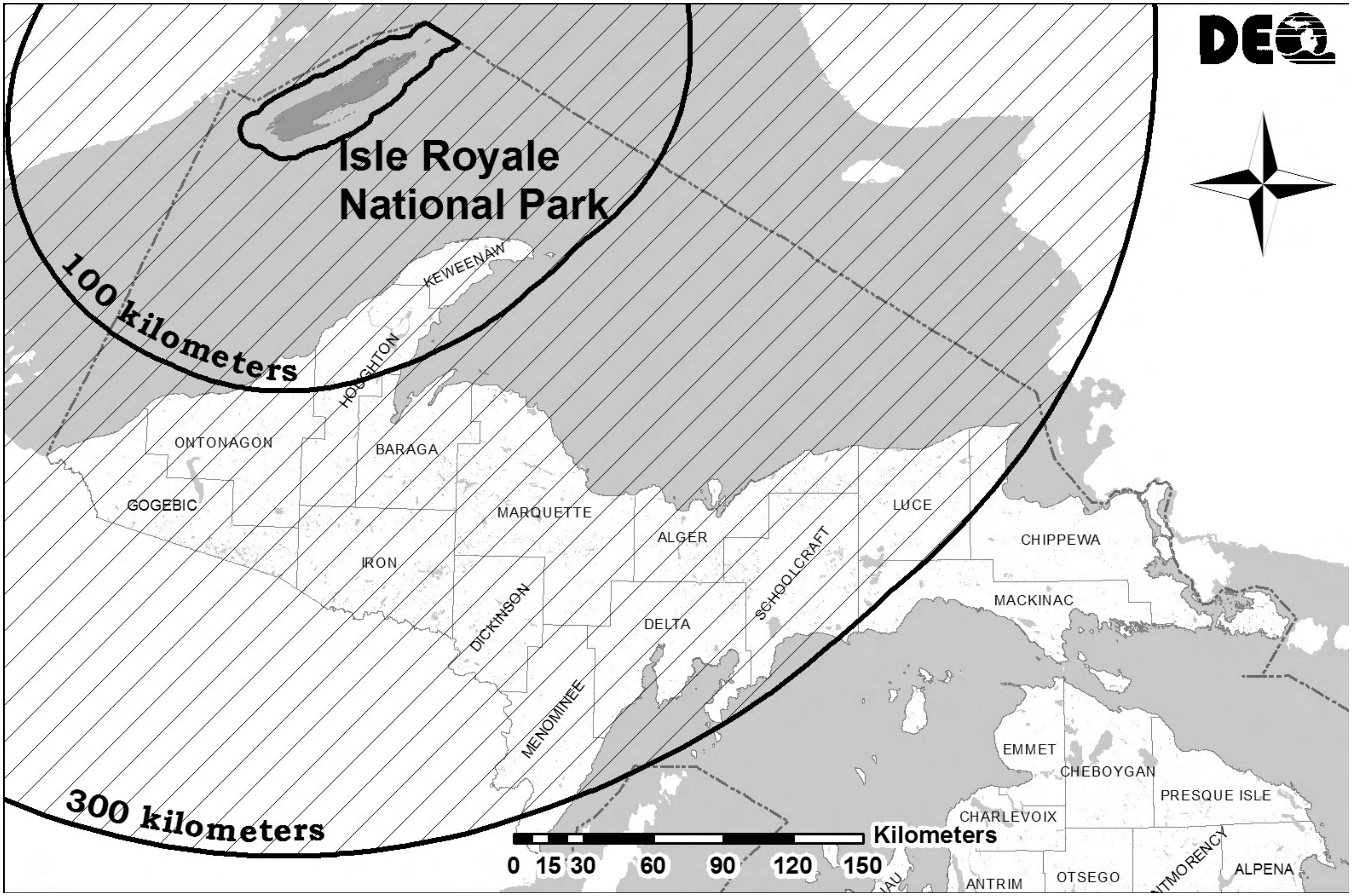
FIGURE 1



Seney National Wildlife Refuge
100 kilometers
300 kilometers
KEWEENAW
HOUGHTON
ONTONAGON
BARAGA
GOGEBIC
MARQUETTE
ALGER
LUCE
CHIPPEWA
IRON
SCHOOLCRAFT
MACKINAC
DICKINSON
DELTA
MENOMINEE
EMMET
CHEBOYGAN
PRESQUE ISLE
CHARLEVOIX
ANTRIM
OTSEGO
MONTMORENCY
ALPENA
LEELANAU
BENZIE
GRAND TRAVERSE
KALKASKA
CRAWFORD
OSCODA
ALCONA
MANISTEE
WEXFORD
MISSAUKEE
ROSCOMMON
OGEMAW
IOSCO
ARENAC
MASON
LAKE
OSCEOLA
CLARE
GLADWIN
HURON
BAY
OCEANA
MECOSTA
ISABELLA
MIDLAND
TUSCOLA
SANILAC
MONTCALM
GRATIOT
SAGINAW
MUSKEGON
Kilometers
0 25 50 100 150 200 250

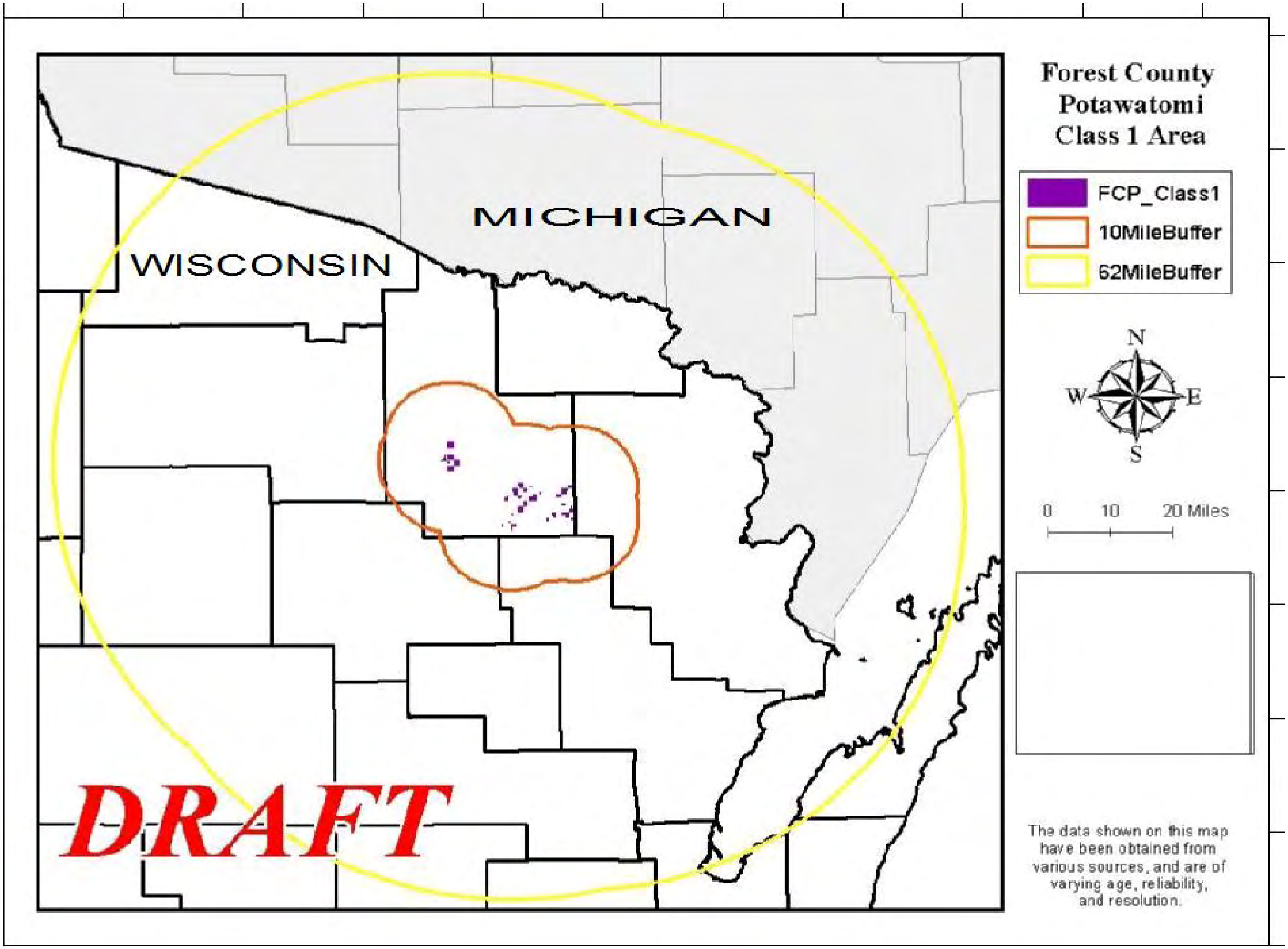
FIGURE 2

*



Isle Royale
National Park
100 kilometers
300 kilometers
KEWEENAW
HOUGHTON
ONTONAGON
BARAGA
GOGEBIC
MARQUETTE
ALGER
LUCE
CHIPPEWA
IRON
SCHOOLCRAFT
MACKINAC
DICKINSON
DELTA
MENOMINEE
EMMET
CHEBOYGAN
PRESQUE ISLE
CHARLEVOIX
ANTRIM
OTSEGO
ALPENA
Kilometers
0 15 30 60 90 120 150

FIGURE 3


Forest County
Potawatomi
Class 1 Area
FCP_Class1
10MileBuffer
62MileBuffer
MICHIGAN
WISCONSIN
N
W
E
S
0
10
20 Miles
DRAFT
The data shown on this map have been obtained from various sources, and are of varying age, reliability, and resolution.

5.0 Nonattainment Area Modeling Requirements (SO_2, PM10, & CO)

The guidance contained herein generally follows the requirements found in the Code of Federal Regulations, PART 51-REQUIREMENTS FOR PREPARATION, ADOPTION, AND SUBMITTAL OF IMPLEMENTATION PLANS, Appendix S to Part 51-Emission Offset Interpretative Ruling. Atmospheric simulation modeling in these areas is not necessary for VOC and NOx since these are area-wide pollutants and the offset provisions in the AQD's Part 2 administrative rules require proposals to obtain emission reductions (offsets) in an amount greater than the new emissions.

One of the conditions in Appendix S states that emission offsets should provide a "positive net air quality benefit" for the area. Since the air quality impact of SO_2, particulate, and carbon monoxide sources is site dependent, simple area-wide mass emission offsets are not appropriate. For these pollutants involving a new or modified source with significant ton-per-year proposed emissions, the following three-tiered approach should be followed:

TIER 1: If the offsets are obtained from an existing source on the same premises or in the immediate vicinity of the new source, and the pollutants disperse from substantially the same or higher stack height, then no modeling would be required.

TIER 2: If the conditions of Tier 1 are not met, and it can be demonstrated that the overall net change in ambient concentrations will be less than the significant impact levels listed in Table 1, then no further modeling would be required.

TIER 3: If the conditions of Tier 1 and Tier 2 are not met, then a NAAQS modeling demonstration would be required that shows the impact of the applicants sources plus the contributions from nearby sources plus background would be less than the applicable NAAQS.

6.0 Toxic Air Contaminant Modeling Evaluations

Dispersion modeling may also be required to demonstrate compliance with the health-based screening level requirements of Rule 225 for emissions of toxic air contaminants (TACs). Refer to "Toxic Air Contaminants - Demonstrating Compliance with Rule 225" for additional information. Click here to view this pdf document. If you do not have access to the Internet, it may be obtained by contacting the AQD receptionist at 517-373-7023.

The applicant has the option of conducting their own modeling or having the AQD perform the modeling. In either case, the supporting modeling information listed in Appendix A should be submitted to the AQD. The maximum ambient air impact (design value) used for comparison to the Air Quality Division's TAC screening levels should based on the first high impact occurring in ambient air using the most recent year of representative meteorological data.

7.0 Other Modeling Guidance Documents

The following information and guidance documents are available on the AQD website at http://www.michigan.gov/deqair. Click "Assessment and Planning" and "Modeling and Meteorology." To obtain nearby facility source data that includes criteria pollutant emission rates and stack parameters of nearby facilities necessary to conduct a PSD and NAAQS dispersion modeling analysis, or for questions regarding modeling, contact Jim Haywood at 517-241-7478 (haywoodj@michigan.gov).

Item	Description
EPA Air Toxic Risk Assessment Library (ATRA) Volumes 1,2,& 3	This reference library is for conducting air toxics analyses at the facility and community-scale. (http://www.epa.gov/ttn/fera/risk_atra_main.html)
ISC Users Guide – Volumes 1 & 2	EPA guidance for the Industrial Source Complex (ISC3) Dispersion Model
AERMOD, AERMET, & AERMAP Users Guide's	EPA guidance documents for the AERMOD modeling system
Meteorological Data	Weather data used in conjunction with dispersion models
PSD Baseline Dates	Major and minor source baseline dates throughout Michigan that determines whether emissions from a facility consume increment (post baseline)
New Source Review (NSR) Workshop Manual	EPA manual focusing on the PSD portion of the NSR program found in 40 CFR 52.21
Background Values	EPA criteria pollutant monitoring data for Michigan and surrounding states (http://www.epa.gov/air/data/)
Human Health Risk Assessment Protocol – Chapter 3	EPA air dispersion and deposition modeling guidance for evaluating risk from both direct and indirect pathways
EPA's Aermod Implementation Guide	An evolving document containing information on the recommended use of AERMOD for various applica-tions.

8.0 Recommended Models

8.1 AERMOD

The **AERMOD** modeling system replaced ISCST3 as the preferred recommended model for most regulatory modeling applications, as announced in a November 9th, 2005 Federal Register notice, and is listed as such in Appendix A of the EPA's *"Guideline on Air Quality Models,"* (also published as Appendix W of 40 CFR Part 51). After November 9th of 2006, all air use permit modeling demonstrations were required to use the AERMOD Modeling System and it is available off EPA's Support Center for Regulatory Atmospheric Modeling (SCRAM) website (http://www.epa.gov/scram001/). AERMOD requires the use of two preprocessor modules, AERMET and AERMAP that are used to develop necessary files for the model.

The **AERMET** module is the meteorological preprocessor for the AERMOD program. There are three stages to processing AERMET data:

1. Stage 1 extracts meteorological surface and upper air data from archived data files and processes the data through various quality assessment checks;

2. Stage 2 merges all data available for 24-hour periods (NWS and on-site data) and stores these data together in a single file; and

3. Stage 3 reads the merged meteorological data and estimates the necessary boundary layer parameters for use by AERMOD.

Two files are written by AERMET that are used by an AERMOD modeling run. They are the boundary layer parameter file (*.SFC), which contains observed and calculated surface and boundary layer parameters; and the profile file (*.PFL), which contains wind, temperature, and standard deviations of the wind data. The AQD has used AERMET to pre-process both the surface and boundary layer files for all the meteorological stations throughout the State which are available off the AQD web site.

The **AERMAP** module is a terrain preprocessor designed to simplify and standardize the input of terrain elevation data for the AERMOD program. AERMAP raw input terrain data is the Digital Elevation Model (DEM) data obtained from the United States Geological Survey (USGS). DEM data can be obtained from the USGS in either 7.5-minute or 1-degree resolutions. Currently, AERMAP supports both the 7.5-minute and 1-degree DEM data files. DEM files are readily available through the USGS and various third-party commercial vendors. The 7.5-minute DEM format has a resolution of approximately 30 meters by 30 meters and is the preferred choice for use in PSD modeling. Output from AERMAP includes the location and height scale, which are elevations used for the computation of air flow around hills and other terrain features.

8.2 CALPUFF

CALPUFF has been adopted by the EPA's *"Guideline on Air Quality Models,"* as the preferred model for assessing long range impacts on Federal Class I areas, which include Class I PSD increment consumption, visibility, and deposition. Long-range transport is generally considered to apply to distances greater than 50 km from a source. The Interagency Workgroup on Air Quality Modeling (IWAQM) recommends use of CALPUFF for transport distances of order 200 km and less. The use of CALPUFF for characterizing transport beyond 200 to 300 km should be done cautiously with an awareness of the likely problems involved which are described in the IWAQM Phase 2 Summary Report (Dec 1998) available on-line at http://www.src.com/calpuff/regstat.htm. Consultation with the FLM's can help determine the appropriate application of CALPUFF. Further information on downloading the model and other regulatory uses of the CALPUFF modeling system may be found at the same web address listed above.

8.3 Screening Models

Currently the EPA is developing a screening version of the AERMOD model called AERSCREEN. AERSCREEN will allow users to perform an AERMOD screening run based on conservative meteorological data to obtain ambient concentration estimates for all the common averaging times. Until the EPA officially replaces the SCREEN3 model with the AERSCREEN model, SCREEN3 results will still be accepted.

9.0 Meteorological (Met) Data

Dispersion modeling is required to use the most recent representative data available. Spatial representativeness is best achieved by collection of met data obtained from a site in close proximity to a emission source, therefore, site specific data would be preferred if available, otherwise, representative data from a National Weather Service (NMW) may be used. If neither site specific nor representative NWS data is available, the collection of one year of site specific data may be required.

The most recent five-year data sets should be used for PSD applications. For non-PSD applications and evaluations involving toxic air contaminants pursuant to Rule 225, only the most recent year of available data should be used. Preprocessed AERMOD meteorological data is available from the AQD's website at www.michigan.gov/deqair by selecting "Assessment and Planning" from the left menu, choose "Modeling and Meteorology" from the drop-down menu. The surface sites and years available are given in Table 2 with the locations of the sites shown in Figure 1. These files can be used when running the AERMOD model and were developed using the AERMET meteorological preprocessor using surface parameter assumptions representative of the conditions found to exist at most meteorological surface stations, which are typically located at airports.

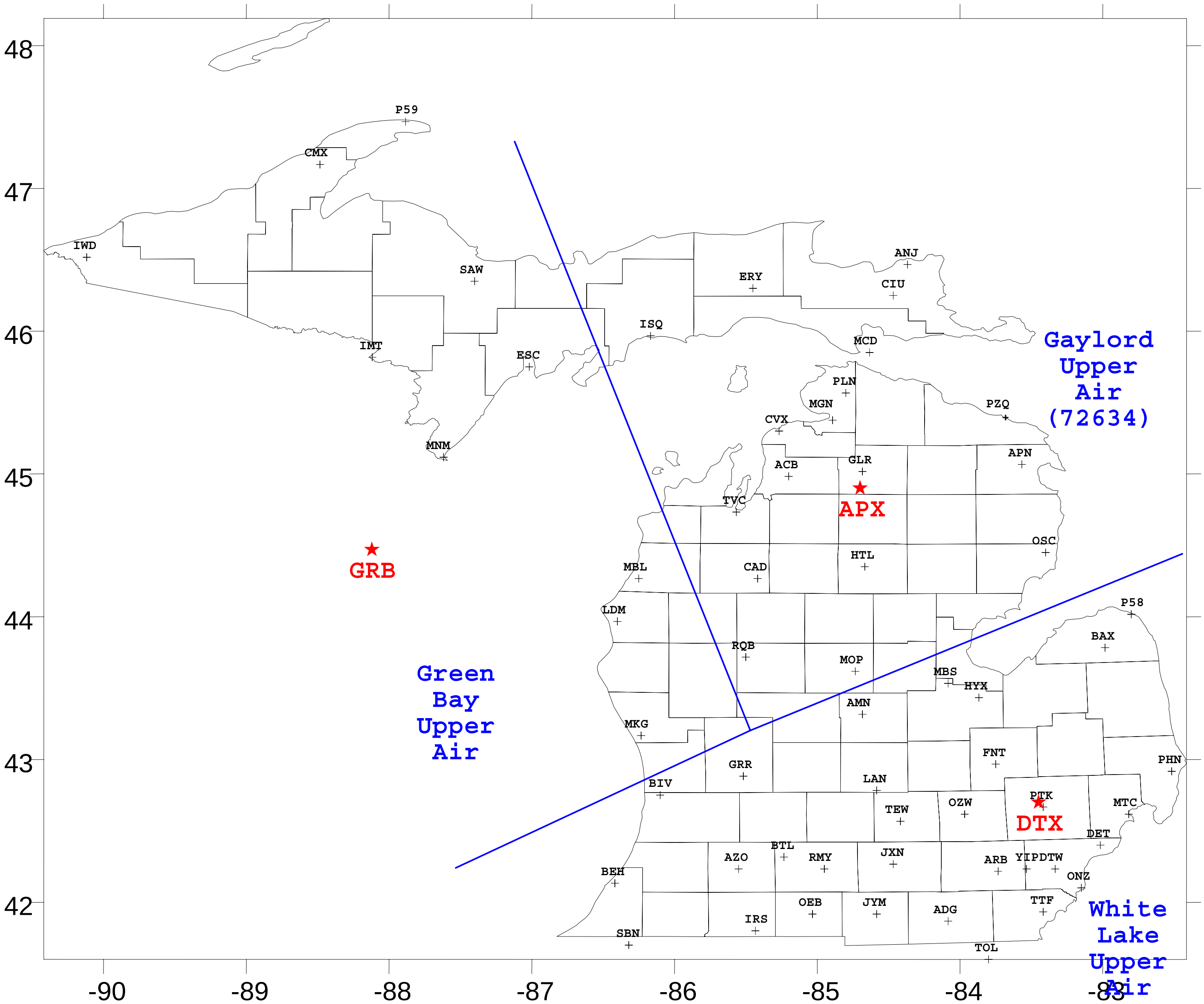
Starting with 2007 meteorological data, the AQD plans to use the recently released EPA AERSURFACE tool to generate realistic and reproducible surface characteristic values, including albedo, Bowen ratio, and surface roughness length, for input to AERMET to generate updated 2003 to 2007 met data sets. The tool uses publicly available national land cover datasets and look-up tables of surface characteristics that vary by land cover type and season. According to the September 27, 2005 document titled "AERMOD IMPLEMENTATION GUIDE" available from EPA's SCRAM web site at http://www.epa.gov/scram001/, the surface parameters should be derived based on the characteristics of the land surrounding the meteorological station used in the modeling and not on the land surround the facility seeking the permit and should be selected based on the guidance found in the EPA's AERMET User's Guide.

TABLE 2

Surface Station	FAA Abbr.	Station Number	Available Years	Upper Air Station	Anemometer Data		MSL Elev Feet	MSL Elev Meters
					Feet	Meters		
Adrian	ADG	14847	02-06	White Lake	33	10.06	791	241
Alma	AMN	15146	03-06	White Lake	33*	10.06*	755	230
Alpena	APN	72639	02-06	Gaylord	33	10.06	689	210
Ann Arbor	ARB	94889	02-06	White Lake	33	10.06	823	251
Bad Axe	BAX	12417	03-06	White Lake	33*	10.06*	768	234
Battle Creek	BTL	14801	03-06	White Lake	33	10.06	951	290
Bellaire	ACB	12662	03-06	Gaylord	33*	10.06*	623	190
Benton Harbor	BEH	94871	03-06	White Lake	33	10.06	627	191
Big Rapids	RQB	14864	03-06	Gaylord	33*	10.06*	991	302
Cadillac	CAD	14817	03-06	Gaylord	33*	10.06*	1306	398
Charlevoix	CVX	14867	02-06	Gaylord	33*	10.06*	669	204
Coldwater	OEB	11675	02-06	White Lake	33*	10.06*	958	292
Copper Harbor	P59	94899	03-06	Green Bay	33	10.06	623	190
Detroit City Airport	DET	14822	03-06	White Lake	33	10.06	623	190
Detroit-Wayne Co.	DTW	94848	02-06	White Lake	33	10.06	640	195
Detroit-Willow Run	YIP	14853	02-06	White Lake	33	10.06	705	215
Escanaba	ESC	72648	02-06	Green Bay	33*	10.06*	614	187
Flint	FNT	14826	03-06	White Lake	33	10.06	764	233
Gaylord	GLR	14854	02-06	Gaylord	33	10.06	1335	407
Grand Rapids	GRR	94860	02-06	White Lake	33	10.06	778	237
Grosse Ile	ONZ	14856	02-06	White Lake	33*	10.06*	591	180
Gwinn	SAW	94836	02-06	Green Bay	33*	10.06*	1220	372
Hancock	CMX	72744	02-06	Green Bay	26	7.92	1070	326
Harbor Springs	MGN	49737	05-06	Gaylord	33*	10.06*	685	209
Hillsdale	JYM	13823	03-06	White Lake	33*	10.06*	1181	360
Holland	BIV	12636	02-06	White Lake	33	10.06	682	208
Houghton Lake	HTL	94814	03-06	Gaylord	33	10.06	1152	351
Howell	OZW	13947	02-06	White Lake	33*	10.06*	961	293
Iron Mountain	IMT	94893	03-06	Green Bay	26	7.92	1145	349
Ironwood	IWD	94926	02-06	Green Bay	33*	10.06*	1230	375
Jackson	JXN	14833	03-06	White Lake	26	7.92	1001	305
Kalamazoo	AZO	94815	02-06	White Lake	33	10.06	892	272
Lansing	LAN	14836	03-06	White Lake	33	10.06	866	264
Ludington	LDM	94816	03-06	Green Bay	33*	10.06*	646	197
Mackinac Island	MCD	14997	03-06	Gaylord	33*	10.06*	741	226
Manistee	MBL	94894	03-06	Green Bay	33*	10.06*	620	189
Manistique	ISQ	14856	03-06	Gaylord	33*	10.06*	686	209
Marshall	RMY	15195	03-06	White Lake	33*	10.06*	942	287
Mason	TEW	15200	03-06	White Lake	33*	10.06*	919	280
Menominee	MNM	94896	03-06	Green Bay	33*	10.06*	627	191
Monroe	TTF	15553	02-06	White Lake	33*	10.06*	617	188
Mount Pleasant	MOP	15677	03-06	Gaylord	33*	10.06*	755	230
Muskegon	MKG	14840	03-06	Green Bay	33	10.06	627	191
Newberry	ERY	15809	03-06	Gaylord	33*	10.06*	869	265
Oscoda	OSC	14808	03-06	Gaylord	33*	10.06*	633	193
Pellston	PLN	14841	03-06	Gaylord	26	7.92	712	217
Pontiac	PTK	94817	02-06	White Lake	33	10.06	981	299
Port Hope	P58	94898	03-06	White Lake	33	10.06	587	179
Port Huron	PHN	94880	02-06	White Lake	33*	10.06*	650	198
Rogers City	PZQ	97089	05-06	Gaylord	33*	10.06*	682	208
Saginaw– MBS Int'l	MBS	14845	02-06	White Lake	33	10.06	663	202
Saginaw - Browne	HYX	14829	03-06	White Lake	33*	10.06*	600	183
Sault Ste Marie - Sanderson Field	ANJ	72734	03-06	Gaylord	33	10.06	715	218
Sault Ste Marie – Chippewa Co.	CIU	12734	03-06	Gaylord	33*	10.06*	801	244
Selfridge	MTC	14804	03-06	White Lake	33*	10.06*	581	177
South Bend, IN	SBN	14848	03-06	White Lake	21	6.4	774	236
Sturgis	IRS	17950	02-06	White Lake	33*	10.06*	925	282
Toledo, OH	TOL	72536	02-06	White Lake	30	9.14	692	211
Traverse City	TVC	14857	03-06	Gaylord	26	7.92	623	190

* Anemometer height for these stations is not known. The default value of 33 feet was used.

Figure 1
Map of Available Meteorological Stations



The above map depicts stations for which surface meteorological data and wind roses are available for download from the DEQ website. All stations are denoted by their three letter abbreviated call sign. Stations in RED are those for which upper meteorological data is available. For more detailed information about each station, please visit the National Climatic Data Center (NCDC) and search based on *call sign*.

10.0 Ambient Background Data

Background concentrations are available for criteria pollutants and may be obtained from the following EPA website: http://www.epa.gov/air/data or by calling any AQD modeling staff. Appropriate criteria pollutant background values should be based on the most recent three years of data from the most representative monitor near the modeling domain that would not be influenced by the sources that would be considered in the modeling analysis and determined by the following methodology:

- For pollutants with annual averaging periods, the highest of the three annual concentrations should be used.
- For pollutants with a 24-hour, 8-hour, 3-hour, or 1-hour averaging period (with the exception of PM10), the second high value from each of the three years should be compared with the highest one used.
- For the 24-hour averaging period for PM10, the fourth highest 24-hour concentration observed over the three-year period should be used.
- For the quarterly averaging period for Pb, the highest quarterly concentration observed over the three-year period should be used.

Data from the last three years will not always be available from an otherwise representative monitor. In these cases, the AQD can be consulted as to which alternatives can be considered. Note that when gathering background concentrations from the EPA website above the concentration for some criteria pollutants are in parts per million by volume (ppm) and would need to be converted to micrograms per cubic meter of air µg/m$^{3.}$.

11.0 Technical Modeling Considerations

11.1 Building Influences

Wind fields are perturbed as they flow around buildings and other structures. This phenomenon is commonly referred to as downwash. Downwash occurs when:

$$H < H_b + 1.5\,H_L$$

where H is the stack height, H_b is the height of the building or structure and H_L is the lesser of the building's height or length. Generally, a building may cause downwash if it is located within 5 H_L of the emitting stack. When employing a model such as AERMOD, the EPA's *Building Profile Input Program (BPIP)* available off EPA's SCRAM website should be used to account for building downwash in the model. The bpip input file should be included in all modeling submittals.

11.2 Elevated Terrain

Consideration of terrain is the regulatory default with the AERMOD model and should be taken into account in most model evaluations. In certain cases of terrain following plumes in sloping terrain, it may be appropriate to apply the non-DFAULT option in AERMOD to assume flat level terrain. This determination should be made on a case-by-case basis, relying on the modeler's experience and knowledge of the surrounding terrain and other factors that affect the air flow in the study area, characteristics of the plume (release height and buoyancy), and other factors that may contribute to a terrain-following plume. The decision to use the non-DFAULT option for flat terrain, and details regarding how it will be applied within the overall modeling analysis, should be documented and justified in a modeling protocol submitted to the reviewing authority. Additional information may be found in Section 4.0 of the "AERMOD IMPLEMENTATION GUIDE" available from EPA's SCRAM web site at http://www.epa.gov/scram001/.

11.3 Ambient Air Receptor Grids

In any modeling demonstration, it is important that the receptor grid (i.e., specific coordinates where the model predicts downwind concentrations) is sufficiently dense to ensure that the point of maximum ambient impact is identified. While each modeling demonstration is unique, grid intervals of 50 meters are generally sufficient to identify the point of maximum impact (i.e., short distance impacts may require an even smaller interval). Polar grids can be used, but the MDEQ generally prefers Cartesian grids since polar grids become less dense farther away from the origin. Discrete receptors should also be placed along secured property lines at intervals not to exceed 25 meters and at any school, hospital, or residence where there is a need to determine pollutant impacts.

NAAQS and PSD increment analyses require receptors to be at ground level. Flagpole (above the ground) receptors can be added when elevated areas such as balconies, rooftops, etc. are of concern with respect to the NAAQS, however, increment impacts should be based on receptors located at ground level. Also, it may be necessary to employ "flagpole" receptors to ascertain the toxic pollutant concentrations at locations such as elevated air intake vents on buildings or hospitals, balconies, bridges, and rooftop restaurants.

11.4 Ambient Air/Secured Property

Ambient air is defined in 40 CFR Part 50.1(e) as "…that portion of the atmosphere, external to buildings, to which the general public has access…," which would include areas such as unsecured plant property, railroad tracks, waterways, and roadways. This definition was further clarified in a letter dated December 19, 1980, from Douglas Costle to Senator Jennings Randolph that stated the exemption from ambient air is available only for the atmosphere over land owned or controlled by the source and to which public access is precluded by a fence or other physical barriers. Receptors generally do not need to be placed within secured property. A "secured property line" means a boundary that prevents general public access to property owned by a facility. In certain circumstances, one or more combinations of other barriers and measures such as ones listed below may adequately deem an area as being "secured"; however, this would be subject to the approval of the Department on a case-by-case basis.

- A body of water, such as a ditch, of sufficient size to preclude public access to the property. The body of water must not be available for recreational activities, such as boating, fishing or swimming.
- Regular patrols by staff that are responsible for not allowing unauthorized personnel onto the property. The patrol must be conducted at least several times a day.
- Continuous monitoring by surveillance cameras where staff is assigned to view video monitors and report any unauthorized access.
- All boundaries using the above methods must be clearly posted to communicate private property/no public access.

11.5 Obstructed Flows/Non-Vertical Discharges/Rain Sleeves

Stacks that are obstructed or point horizontally or downward will have less plume rise than a vertically-oriented stack having otherwise similar characteristics. To account for this reduced plume rise, the following adjustments should be made:

Stack Parameter	***Horizontal Stacks/Rain Cap/ Wind Turbine Vent***	***Goose Neck Down***	***Rain Sleeves***
Velocity (m/s)	see below	0.001 m/s	vel of inner flue
Temperature (K)	see below	294 K	unchanged
Stack Height (m)	see below	unchanged	Stack+sleeve ht

For stacks that are fitted with a RAIN CAP or have a HORIZONTAL ORIENTATION, the guidance found in EPA's AERMOD IMPLEMENTATION GUIDE (available from EPA's SCRAM website) should be followed. The portion of this guidance portion pertaining to capped and horizontal stacks is shown below:

CAPPED AND HORIZONTAL STACKS (from EPA's AERMOD IMPLEMENTATION GUIDE)

"For capped and horizontal stacks that are NOT subject to building downwash influences a simple screening approach (Model Clearinghouse procedure for ISC) can be applied. That is, an effective stack diameter may be used to maintain the flow rate, and hence the buoyancy, of the plume, while suppressing plume momentum by setting the exit velocity to 0.001 m/s. To appropriately account for stack-tip downwash, the user should first apply the non-default option of no stack-tip downwash (i.e., NOSTD keyword). Then, for capped stacks, the stack release height should be reduced by three actual stack diameters to account for the maximum stack-tip downwash adjustment while no adjustment to release height should be made for horizontal releases. Capped and horizontal stacks that are subject to building downwash, should not use an effective stack diameter to simulate the restriction to vertical flow since the PRIME algorithms use the stack diameter to define the plume radius which, in turn, is used to solve conservation laws. The user should input the actual stack diameter and exit temperature but set the exit velocity to a nominally low value, such as 0.001 m/s. This approach will have the desired effect of restricting the vertical flow while avoiding the mass conservation problem inherent with effective diameter approach. The approach suggested here is expected to provide a conservative estimate of impacts. Also, since PRIME does not explicitly consider stack-tip downwash, no adjustments to stack height should be made."

11.6 Land Use Classification (Urban/Rural)

The selection of either rural or urban dispersion coefficients in a specific application should follow one of the procedures described below.

Land Use Procedure:

1. Classify the land use within the total area (A_o) circumscribed by a 3-km radius around the source using the land use typing scheme proposed by Auer (1978).
2. If land use types I1, I2, C1, R2 and R3 account for 50 percent or more of A_o, use urban dispersion coefficients; otherwise, use appropriate rural dispersion coefficients.

Population Density Procedure:

1. Compute the average population density (p) per square kilometer with A_o as defined above.
2. If p is greater than 750 people/km^2, use urban dispersion coefficients; otherwise use appropriate rural dispersion coefficients.

Of the two methods, the land use procedure is considered more definitive**. Population density** should be used with **caution.** It should not be applied to highly industrialized areas where the population density may be low and thus a rural classification would be indicated, but the area is sufficiently built-up so that the urban land use criteria would be satisfied.

Also, there may be sources located within an urban area, but located close enough to a body of water or to other non-urban land use categories to result in a predominately rural land use classification within 3 kilometers of the source following the land use procedure. Users are therefore ***cautioned*** against applying the Land Use Procedure on a source-by-source basis, but should also consider the potential for urban heat island influences across the full modeling domain. Furthermore, Section 7.2.3(f) of Appendix W recommends modeling all sources within an ***urban complex*** using the urban option even if some sources may be defined as rural based on the land use procedure. Such an approach is consistent with the fact that the urban heat island is not a localized effect, but is more **regional** in character.

Another aspect of the urban/rural determination that may require special consideration on a case by-case basis relates to tall stacks located within or adjacent to small to moderate size urban areas. In such cases, the stack height, or effective plume height for very buoyant plumes, may extend above the urban boundary layer height. Application of the urban option in AERMOD for these types of sources may artificially limit the plume height. Therefore, use of the urban option **may not be appropriate** for these sources, since the actual plume is likely to be transported over the urban boundary layer. The determination of whether these sources should be modeled separately without the urban option will depend on a comparison of the stack height or effective plume height with the urban boundary layer height. More information regarding this determination can be found in the "AERMOD IMPLEMENTATION GUIDE" available from EPA's SCRAM web site (http://www.epa.gov/scram001/).

11.7 Fugitive Emissions Modeling

For PSD modeling, fugitive dust emissions should be included in the analysis to the extent they are quantifiable and are defined as those emissions which could not reasonably pass through a stack, chimney, vent, or other functionally equivalent opening. Examples of quantifiable fugitive emission sources include coal piles, road dust, quarry emissions, and aggregate stockpiles. For non-PSD modeling reviews, the permit engineer will ascertain on a case-by-case basis whether fugitive dust emissions should be included in the analysis, based on the amount of emissions and how closely they are associated with the operations and activities at the facility. Below are some general guidelines to help categorize a particular source and specific recommendations for deriving the required input parameters of the more common types of fugitive emission sources.

Area Sources: An area source should be used to simulate emissions that initially disperse in two dimensions with little or no plume rise, such as ground-level or low-level emissions from a **storage pile, slag dump, landfill, or holding pond**. Area sources use an emission rate per unit area instead of total emission, which is calculated by dividing the total emissions in grams per second by the total area in square meters.

Volume Sources: Volume sources are used to simulate emissions that initially disperse in three dimensions with no plume rise, such as emissions from **roadway truck/vehicle traffic, coke batteries, building vents, conveyor transfer points, screens and crushers, and truck loading/unloading.**

A recommended method to determine if a volume source is on or adjacent to a structure is to assess whether the structure is greater than 50 percent solid. The release height, initial lateral dimension (σ_y), and initial vertical dimension (σ_z) should, in general, be determined according to the suggestions the AERMOD User's Guide and the recommendations in Section 11.8.

Pseudo Point Sources: Certain release scenarios such as isolated sidewall vents or a limited number of roof vents could be characterized as a pseudo point source. Horizontal discharges should follow the applicable guidance contained in Section 11.5. For a passive roof vent modeled as a point source, the exit velocity should be set to .001 m/s.

11.8 Recommended Modeling Characterizations for Typical Fugitive Dust Sources

Storage Piles

Storage piles should be simulated as an area source with the following input parameters:

Release Height = [Height of Pile] / 2
Initial Vertical Dimension (σ_z) = 0 (optional parameter)

The release height is based on the premise that the wind speed increases with height and the surface area decreases, which tend to counteract each other in terms of emissions. The initial vertical dimension should be 0 because wind erosion emissions from a pile doesn't have a plume depth, unlike emissions generated by mechanical agitation such as material transfer from a conveyor.

Roadway Emissions from Trucks/Vehicles

Roadways should be simulated as volume sources using the modeling input parameters derived as shown below:

Side Length of Volume = Truck Width + 6 meters
Height of Volume Src = Vehicle Height x 2.0
Release Height = Volume Ht / 2.0
Initial Horizontal Dim (σ_y) = Vol Width / 2.15 (adjacent vol src's)
or
Initial Horizontal Dim (σ_y) = Center to Center Dist / 2.15 (separated vol src's)
Initial Vertical Dim (σ_z) = Height of Vol / 2.15

These suggestions are similar to guidance found in other areas of the Country to promote consistent results among the regions.

Building Roof /Side Vents

Building roof & side vents are categorized as single, elevated sources on a structure and should be simulated using the volume source input parameters derived as shown below:

To simulate emissions that emanate from roof & side vents on a building, the following volume source parameters should be used:

Release Height = Height of vent midpoint
Initial Horizontal Dimension (σ_y) = Avg. Building Width / 4.3
Initial Vertical Dimension (σ_z) = [Bldg Height] / 2.15

A release height calculated this way simulates the release with maximum amount of emissions occurring at the roof vent opening, and the initial horizontal and vertical dimensions accounts for the building wake effect on the initial plume growth.

Conveyors

Conveyors that transport material into a building or silo would be categorized as a single elevated volume source on or adjacent to a structure. Emissions from the transfer of material from one conveyor to another or to a storage pile would be categorized as a single elevated volume source not on or adjacent to a building. The appropriate volume source modeling parameters would depend on which of these categorizations applies, as shown below:

Parameter	*Conveyor into Silo/Bldg*	*Conveyor1 to Conveyor2 or Pile*
Release Height	Ht where conveyor enters Bldg	Midpt of drop distance
Initial Horz Dim	Width of Conveyor / 4.3	Width of Conveyor / 4.3
Initial Vert Dim	Height of Bldg or Silo / 2.15	Conv1 to Conv2 drop dist / 4.3

Crushers & Screening

Again, proper derivation of the appropriate volume source modeling parameters for these source types involves ascertaining whether the source is surface-based or elevated on or adjacent to a building. This determination affects how the initial vertical dimension is calculated as shown below:

Parameter	*Surface Based*	*Elevated not on or adjacent to a Bldg*	*Elevated on or adjacent to a Bldg*
Release Ht	Height of Crusher	Height of Crusher	Height of Crusher
Init Horz Dim	Avg Crusher Width/ 4.3	Avg. Crusher Width / 4.3	Avg Crusher Width/4.3
Init Vert Dim	Max Ht of Crusher / 4.3	Vert Dim of Source / 4.3	Height of Bldg. / 2.15

Truck Loading with Front-End Loader

Emissions are created when material is dropped from the loader bucket into a haul truck. Since the emissions would have to waft over the truck bed to be released, the release height should be set to the top of the truck bed. The initial horizontal dimension should be based on the width of the loader bucket and the initial vertical dimension should be based on the drop distance of the loaded material (same as truck bed sidewall) as noted below:

Release Height = Top of Truck Bed Height
Initial Horizontal Dimension (σ_y) = Width of Front End Loader Bucket / 4.3
Initial Vertical Dimension (σ_z) = Truck Bed Sidewall Height / 4.3

Truck Loading from Silo/Bin

Trucks usually drive under a bin or silo where material is dropped into the truck bed creating a plume of emissions and would be considered a single elevated source on or adjacent to a structure. The release height should be based on the drop distance midpoint between the silo bottom and the truck bed, and the initial vertical and horizontal dimensions on the silo to account for building wake effects, as shown below;

Release Height = Midpoint of Material Drop Distance
Initial Horizontal Dimension (σ_y) = Width of Silo / 4.3
Initial Vertical Dimension (σ_z) = Height of Silo / 2.15

Truck Unloading

Emissions are created when a haul truck dumps material to a pile or feeder and would be considered a single elevated source on a structure with the structure being the truck. The release height should be set at the height of the truck bed, and the initial horizontal and vertical dimensions, as shown below:

Release Height = Height of Truck Bed
Initial Horizontal Dimension (σ_y) = Width of Truck / 4.3
Initial Vertical Dimension (σ_z) = Height of Truck / 2.15

If it is unclear how to characterize a fugitive emission source, please contact Jim Haywood at 517-241-7478 (HaywoodJ@michigan.gov) in the modeling group at 517-373-7023.

11.9 Flares

Flares are a special type of source that may be modeled as a point source with some adjustments. The EPA SCREEN3 model can be used to predict ambient impacts from these types of sources; however, the total heat release rate in calories/sec is required as an additional modeling input. SCREEN3 uses the total heat release information to calculate an effective release height that is used to determine the 1-hr average maximum ambient concentration.

Most modeling software currently available has procedures to handle modeling flare sources that generally follow acceptable EPA methodologies. Flares can be modeling as a point source in a refined model such as AERMOD by following the procedure outlined below, which is contained in the EPA document "WORKBOOK OF SCREENING TECHNIQUES for ASSESSING IMPACTS of TOXIC AIR POLLUTANTS" (Dec 92).

<u>Flare Modeling Procedure</u>

Flares can be modeling as a psuedo point source using preferred regulatory refined models such as AERMOD using the technique below to derive the modeling input parameters needed for point sources.

Step 1 - Calculate the **Total Heat Released (Q_T)** by multiplying the heating value of the flare gas by the gas flow rate to obtain total potential gross heat release in calories per second (cal/s).

Step 2 - Calculate the sensible or N**et Heat Available (Q_H)** for plume rise enhancement in cal/s by multiplying the total heat released by 0.45 which assumes that 55 percent of the total heat is lost due to radiation.

$$Q_H = (0.45)\ Q_T$$

Step 3 – Determine the effective flare stack diameter in meters (m) based on the net heat released as follows:

$$D_{eff} = 9.88\text{x}10^{-4}\ (Q_H)^{0.5}$$

Step 4 – Calculated the **Effective Release Height (H_e)** using **the formula below**

$$H_{eff} = H_S + [0.00456 \text{ x } (Q_T)^{0.478}]$$

where: H_s = physical stack ht above ground in meters (m)
Q_T = Total Heat Released (J/s)

Step 5 – Use the effective release height and diameter as calculated above, and an assumed stack gas exit velocity (**V_e**) of 20 m/s and gas exit temperature **(T_e)** of **1273 K** as point source modeling inputs to model.

11.10 Odor Modeling

The following procedure describes the modeling methodology used when dilution to threshold (D/T) information is available for a stack gas. An ambient concentration of 1 D/T or 1 Odor Unit (OU) means that the odor is just barely perceptible. This procedure yields ambient odor concentrations in terms unit of D/Ts or OUs .

1. <u>Determine the Odor Emission Rate</u>: Multiply the D/T stack value by the volumetric flow rate in cubic meters per second. Then either multiply this product by 1 x 10E6 to account for default conversion factor of 1 x 10E6 that is imbedded in the ISC model used to convert grams to micrograms, or use the EMISUNIT keyword in the

Source pathway to specify a conversion factor of 1, which overrides the default conversion factor yielding modeling results in units of D/Ts.

2. Input Odor Emission Rate: Input the odor emission rate into the model in place of the grams per second emission rate.

3. Run Model: Run model to produce a 1-hr average estimate and multiply this value by 2 to arrive at a 10-min average concentration, which is used for odor evaluations. The 10-min concentration predicted by the model would be in units of D/Ts.

11.11 Fumigation

Fumigation occurs when a plume is emitted into a stable layer of air and that layer is subsequently mixed to the ground. Mixing occurs through convective transfer of heat from the surface or by advection to less stable surrounding air layers. Fumigation may cause excessively high concentrations but is usually rather short-lived at a given receptor. Fumigation is also an important phenomenon on and near shorelines. This can affect both individual plumes and area-wide emissions. When fumigation conditions are expected to occur from a source or sources with tall stacks located on or just inland of a shoreline, this should be addressed in the air quality modeling analysis. The Shoreline Dispersion Model available from the EPA's SCRAM website under "Preferred/Recommended Models" may be applied on a case-by-case basis when air quality estimates under shoreline fumigation conditions are needed.

References

Auer, A.H. 1978. Correlation of land use and cover with meteorological anomalies. *Journal of Applied Meteorology*, 17: 636-643.

Michigan Department of Environmental Quality, *Administrative Rules for Air Pollution Control, Part 1 - General Provisions*.

Michigan Department of Environmental Quality, *Administrative Rules for Air Pollution Control, Part 2 - Air Use Approval*.

U.S Environmental Protection Agency. *A Workbook of Screening Techniques for Assessing Impacts of Toxic Air Pollutants*, EPA 454/R92-024.

U.S. Environmental Protection Agency *Guideline on Air Quality Models, 40 C.F.R Part 51, Appendix W.*

U.S. Environmental Protection Agency. *Interim Procedures for Evaluating Air Quality Models*, EPA 450/4-84-023.

U.S. Environmental Protection Agency. September 1995. *SCREEN3 Model User's Guide*, EPA 454/B-95-004.

U.S. Environmental Protection Agency. August 1988. *Screening Procedures for Estimating the Air Quality Impact of Stationary Sources*, EPA 450/4-88-010.

U.S. Environmental Protection Agency. September 1995. *User's Guide for the Industrial Source Complex (ISC3)*, EPA 450/B-95-003a.

Zannetti, Paolo. 1990. *Air Pollution Modeling, Theories, Computational Methods and Available Software*. Van Nostrand Reinhold. New York: NY.

St. Croix Kathryn, Goodman Abby, Heinerikson Arron, June 2003, *Defining Appropriate Source Characteristics When Modeling Fugitive Sources,* Air & Waste Management Paper #69765.

U.S. Environmental Protection Agency. September 2004. *USER'S GUIDE FOR THE AMS/EPA REGULATORY MODEL – AERMOD,* EPA-454/B-03-001

U.S. Environmental Protection Agency. November 2004. *USER'S GUIDE FOR THE AERMOD METEOROLOGICAL PREPROCESSOR (AERMET*), EPA-454/B-03-002.

U.S. Environmental Protection Agency. October 2004. USER'S GUIDE FOR THE AERMOD TERRAIN PREPROCESSOR (AERMAP), EPA-454/B-03-003.

U.S. Environmental Protection Agency. January 2008. *AERMOD IMPLEMENTATION GUIDE.*

U.S. Forest Service (Air Quality Program); National Park Service – (Air Resources Division); U.S. Fish and Wildlife Service (Air Quality Branch). December 2000. *FEDERAL LAND MANAGERS' AIR QUALITY RELATED VALUES WORKGROUP (FLAG) - PHASE I REPORT*

APPENDIX A
Information Required For Dispersion Modeling

Please provide the following information, including units, for each pollutant (criteria and toxic air contaminant) emitted from each stack. This information is required whether the applicant or AQD is performing the modeling. For multiple pollutants emitted from multiple stacks, the information may be submitted in a spreadsheet format.

STACK INFORMATION

1. Name of stack or stack identifier
2. Height of stack from ground level (feet or meters)
3. Exit temperature of exhaust gas (°F or °C)
4. Inside diameter or length and width of stack (ft or m)
5. Exit velocity of exhaust gas (ft/s or m/s) OR:
   Volumetric flow rate (acfm, m^3/s)
6. Stack location (UTMs or Local)*
7. Stack Orientation (i.e., vertical, horizontal, gooseneck)
8. Stack Obstructions (rain caps, other)
9. Emission Rate of each pollutant from this stack (lbs/hr or g/s)
10. For FLARES the heat content (Btu/ft3) and flow rate of the gas should be provided

* For UTM coordinates please indicate which North American Datum System was used i.e., NAD 1927 or NAD 1983.

VOLUME SOURCE INFORMATION (if applicable)

1. Name of volume identifier
2. Release height (center of volume) (feet or meters)
3. Initial lateral dimension of the volume (meters)
4. Initial vertical dimension of the volume (meters)
5. Center of volume location (UTMs or Local)*
6. Emission Rate of each pollutant from this volume (lbs/hr or g/s)

*Provide North American Datum System used (i.e., NAD 1927 or NAD 1983) or Local origin. If local coordinates are used, provide a UTM coordinate for the origin.

AREA SOURCE INFORMATION (if applicable)

1. Name of area identifier
2. Release height above ground (feet or meters)
3. Length of X side (in east-west direction if angle is 0)
4. Length of Y side (in north-south direction if angle is 0)
5. Area rectangle orientation angle from north (degrees)
5. Southwest corner of area source (UTMs or Local)*
6. Emission Rate of each pollutant from this area (g/(s-m^2))

*Provide North American Datum System used (i.e., NAD 1927 or NAD 1983) or Local origin. If local coordinates are used, provide a UTM coordinate for the (0,0) location.

BUILDING INFORMATION

1. Peak roof height from ground level
2. Heights of any higher sections (tiers) on main roof
3. Building Dimensions, length and width
4. Building Location via Local or UTM coordinates or Plot Plan

Please provide the above information for all buildings/structures within a distance of five (5) times the height of that building/structure to any stack

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SITE INFORMATION

Please provide a plot plan which includes all of the following:

1. North arrow
2. Distance scale
3. Location of all stacks, volumes, and areas being modeled
4. All buildings/structures located within a distance of 5 times its height to any stack being modeled
5. All property lines
6. Any fence lines, berms, other public access barriers.

ELECTRONIC DATA FILES - CD OR FLOPPY DISK

1. Copy of the modeling input files (*.inp, *.dat, *.dta, *.api)
2. For AERMOD a copy of the Stage 1 and 3 AERMET input files (*.in1, *.in3)
3. For AERMOD a copy of the AERMAP output file (*.rou)
4. Copy of the building profile input (bpip) file (*.bpi)
5. Copy of the modeling output files (not as important as the two first items, but helpful)
6. Toxic Air Contaminant lists/spreadsheets including emission rates, screening levels, and impacts.

ATTACHMENT 1
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460
OFFICE OF
AIR, NOISE, AND RADIATION

DATE: March 19, 1979

SUBJECT: Notification to Federal Land Manager Under Section 165 (d) of the Clean Air Act

FROM: David G. Hawkins, Assistant Administrator for Air, Noise, and Radiation (ANR-443)

TO: Regional Administrator, Regions I-X

The 1977 Clean Air Amendments require the Administrator, under Section 165 (d) 2 (A), to "provide notice of the permit application to the Federal Land Manager and the Federal official charged with direct responsibility for management of any lands within a Class I area which may be affected from a proposed new facility." As you know the Amendments give the Federal Land Manager important new responsibilities for the protection of Class I areas established by Congress. In order to fulfill these responsibilities without causing undue delay in the PSD permit process, EPA should make every effort to provide the Federal Land Manager with as much time as possible to evaluate the effects of the proposed facility's emissions on the air quality related values of nearby Class I areas.

Accordingly, each Regional Office should establish a mechanism to ensure that notice is provided to the Federal Land Manager immediately upon receipt of a permit application. In some areas however, depending on the size of the facility and its proximity to a Class I area, it may also be appropriate to notify the Federal Land Manager of the pre-application conference with the owner of a proposed facility. Until we have prepared guidance on determining the impacts a source may have on "air quality related values", notice should be provided for any facility which will be located within 100 kilometers of a Class I area. Very large sources, however, may be expected to affect "air quality related values" at distances greater than 100 kilometers. The appropriate Federal Land Manager should be notified if such impacts are expected on a case-by-case basis.

In order to ensure adequate notification, you should notify not only the Federal Land Manager and the Federal official directly responsible for the Class I area but also certain other Federal officials who will be involved in implementing the Federal Land Managers responsibilities under the Act. With this memorandum, I have enclosed a list of the appropriate Federal officials for each of the mandatory Class I areas under the jurisdiction of the National Park Service. Similar listings for the U.S. Fish and Wildlife Service and the U.S. Forest Service will be sent to you at a later date. These lists will be updated periodically as personnel changes occur and new Class I areas are designated.